Szekely, Peter

From: Releford, Carol
Sent: Monday, July 10, 2006 12:45 PM
To: Szekely, Peter
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2,032,948.su.doc

Hi Peter,

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POLYMER COMPOSITION

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ABSTRACT OF INVENTION
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POLYMER COMPOSITION

[Polimernaya kompozitsiya]

Inventors:	S. I. Petrukhnenko et al.
Grantee:	Scientific Research Institute of Plastics named for G. S. Petrov with the Moscow Experimental Plant for Plastics

The invention relates to polymer composition materials that shield electromagnetic radiation. These materials are used for injection molding of the housings and parts of electronic devices that protect these devices from the undesirable effect of electromagnetic noise. The materials used for these purposes must have high shielding factors and at the same time, low volume resistivity.

Currently there are no domestic injection molded composition shielding materials (CSM).

There is a known CSM consisting of a thermoplastic material and stainless steel (SS) fibers enclosed in a polymer envelope that is compatible with the polymer matrix. The concentration of SS fibers is 0.05-0.5 percent by volume.

There is also a known composition that contains thermoplastic and fibers of stainless steel that have been soaked beforehand in solutions of oligomers. The amount of added SS fibers is 0.5-60 percent by weight.

It is also possible to add special additives to these compositions: lubricants (of the class of the amides and salts of fatty acids), plasticizers (esters of phthalic acid, fatty carboxylic acids, etc.), fireproofing agents and colorants.

The basic shortcomings of these compositions are a low degree of shielding, high volume resistivity, and also high costs because of the high concentration of expensive filler.

The technical solution closest to the invention is a composition that contains: a thermoplastic (ABS plastic, linear polyesters, polyphenylene oxide, polycarbonate) and fibers of stainless steel that have been impregnated and coated with an envelope of a polymer that serves in compounding the matrix.

In the references cited earlier and in the prototype, the material that is used for impregnation and coating of the bundle of SS fibers is compatible and similar in nature to the matrix polymer.

Shortcomings of the prototype are insufficient degree of shielding, high volume resistivity, and high costs of the composition material and articles made from it.

The essence of the invention is that the known composition contains a thermoplastic, fibers of stainless steel and a polymer additive. Plasticized or unplasticized polyvinyl chloride is used as the polymer additive in the following ratio of components, parts by weight: 55-90 parts thermoplastic, 1-10 parts polyvinyl chloride, 5-35 parts stainless steel fiber.

Polyamide, polyolefins, styrene polymers, polyalkylene terephthalates are used as the thermoplastic.

The task of the present invention is the creation of a polymer composition with high degree of shielding of electromagnetic radiation and low volume resistivity, while maintaining the physical mechanical properties of the CSM at the starting level. The composition that is created, owing to a reduction of the amount of expensive filler, should have lower costs, i.e., be cheaper.

This technical result is achieved only if the aggregate of the important characteristics of the proposed invention is used.

Analysis of the proposed and known solutions shows that there is no aggregate of features identical in technical essence to the proposed composition. A comparative analysis of the disclosed solution and the prototype shows that the proposed composition differs from the known composition by the use of polyvinyl chloride as the polymer additive and a new ratio of components in the composition. Thus, the proposed composition meets the criterion of "novelty."

In the literature and in practice there is no data concerning such a composition of compositions that shield electromagnetic radiation and thus does not explicitly follow from the prior art, since an improvement of the efficiency of shielding and a reduction of the volume resistivity when polyvinyl chloride is added to a mixture of thermoplastic and SS fiber is not known. This allows the conclusion that the disclosed technical solution meets the criterion "inventive level."

The proposed technical solution assures achievement of the technical result, can be realized in the production of the compositions described above, and supports the possibility of repeated reproduction of it, which allows the conclusion that it satisfies the criterion "industrial applicability."

The following are used as materials in producing the composition: polyvinyl chloride, GOST [All-Union State Standard] 5960-72 up to January 1, 1994;

Stainless steel fibers, TU [technical specification] 14-1-1702-76;

Polyamides, OST [Branch Standard] 6-06-C9-83;

Polyolefins, GOST 26996-86;

Styrene polymers, TU6-05-1587-79;

Polyethylene terephthalates, TU6-051984-85;

Polybutylene terephthalates, TU6-06-21-89

Table 1 gives compositions of the examples and the prototype.

Table 2 gives the properties of the compositions from the examples and the prototype.

Example 1. A composition that shields electromagnetic radiation is obtained by mixing 86 g (86 parts by weight) polyamide 6, type 210/310 and 14 g (14 parts by weight) tablets consisting of 10 g stainless steel (10 parts by weight) and 4 g of an envelope of plasticized polyvinyl chloride (4 parts by weight) in the melt on a twin screw extruder. Tablets 3-4 mm in diameter and 5-6 mm in length (height) are obtained by chopping a continuous bundle of stainless steel fibers enclosed in a polyvinyl envelope. The strand obtained at the extruder outlet is chopped into granules of standard size (length 2-5 mm and diameter 3-4 mm), which are subsequently easily reprocessed into articles of various configuration by injection molding.

Example 2. A composition that shields electromagnetic radiation is obtained by compounding a mixture of 86 g (86 parts by weight) granules of polyamide 6, type 210/310 and 4 g (4 parts by weight) granules of unplasticized polyvinyl chloride with 10 g (10 parts by weight) fibers of stainless steel. The strand obtained at the extruder outlet is chopped into granules 2-5 mm long and 3-4 mm in diameter, which are subsequently easily reprocessed by extrusion molding.

Examples 3-5. The preparation technology is similar to what was described in Example 1. The composition is given in Table 1.

Examples 6-7. The preparation technology is similar to what was described in Example 2. The composition is given in Table 1.

Examples 8-9. The preparation technology is similar to what was described in Example 1. The composition is given in Table 1.

Examples 10-11. The preparation technology is similar to what was described in Example 2. The composition is given in Table 1.

Examples 12-13. The preparation technology is similar to what was described in Example 1. The composition is given in Table 1.

Examples 14-18. The preparation technology is similar to what was described in Example 1. The composition goes beyond the disclosed limits.

Tests were conducted by the following techniques: specific resistivity ($\rho_v \cdot$ Ohm $\cdot$ m) was determined on cast sample 7 cm x 7 cm x 4 mm in size. Total resistance of the sample (R_{total}, Ohm) was measured with fused electrodes made of metal screen; ρ_v was calculated by the formula $\rho_v = R_{total} (\delta \cdot b)/l$ where δ is the thickness of the sample, l is the distance between electrodes, and b is the width of the sample.

It is known that the results of measuring the shielding efficiency by special techniques for different test chamber designs cannot be compared with each other and that only an approximate comparison can be made.

In connection with this, we conducted tests of the composition that we are proposing and the composition according to the prototype in the same test facility under the same conditions.

The shielding characteristics of the CSMs were determined by a technique that was specially developed at the Central Design Office or Radiomaterials, Moscow, separately for the electric and magnetic components of the electromagnetic field in the near field.

As follows from Table 2, the proposed task was fulfilled. Compared to the prototype, the degree of shielding improved, volume resistivity decreased, and the basic physical mechanical characteristics of the material are retained.

The cost of the resulting material was reduced by a factor of 1.5-2 because of the possibility of reducing the concentration of expensive stainless steel fiber in the composition up to 50%.

Claims

1. A polymer composition containing a thermoplastic, fibers of stainless steel and a polymer additive, which is distinguished by the fact that it contains polyvinyl chloride as the polymer additive in the following ratio of components, parts by weight:

thermoplastic 55-90,

polyvinyl chloride 1-10,

stainless steel fiber 5-35.

2. A composition as in Claim 1, which is distinguished by the fact that it contains plasticized polyvinyl chloride as polyvinyl chloride.

3. A composition as in Claim 1 or 2, which is distinguished by the fact that it contains polyamide, polyolefins, styrene polymers or polyalkylene terephthalates as thermoplastic.

Table 1. Compositions

Пример (1)	НС-волокно, м.ч. (2)	ПВХ (м.ч.) (3) Пластифицированный (5)	Непластифицированный (6)	Термопласт (м.ч.) (4) ПА-6 210/310 (7)	ПА-610 (8)	Полипропилен 21060-16 (9)	АБС-пластик 2020 (10)	Полибутилентерефталат (11)
1	10	4		86				
2	10		4	86				
3	5	5		90				
4	35	10			55			
5	20	4		76				
6	35		10	55				
7	10		1		89			
8	13	4				83		
9	20	4				76		
10	15		4				81	
11	15		10				85	
12	15	4						81
13	20	4						76
(12) При выходе за предложенные пределы								
14	3	2		95				
15	10	0		90				
16	40	0.5		59.5				
17	10	13		77				
18	35	12		53				
(13) Прототип	20	–		80				
Прототип	13	–				87		

Key:

1 Example
2 SS fiber, parts by weight
3 PVC (parts by weight)
4 Thermoplastic (parts by weight)
5 Plasticized
6 Unplasticized
7 PA-6 210/310
8 PA-610
9 Polypropylene 21060-16
10 ABS plastic 2020
11 Polybutylene terephthalate

12 Outside of proposed limits
13 Prototype

Table 2. Properties of Compositions

Пример 1	Удельное объемное сопротивление, Ом/м 2	3 Эффективность экранирования, дБ	
		электрического поля 4 (0.1 МГц)	Магнитного поля 5 (30 МГц)
1	$2{,}8 \cdot 10^{-1}$	11	19
2	$2{,}5 \cdot 10^{-1}$	12	1
3	$4 \cdot 10^{0}$	6	8
4	$5 \cdot 10^{-4}$	78	26
5	$4 \cdot 10^{-3}$	70	26
6	$5{,}5 \cdot 10^{-4}$	77	26

Key: 1 Example
2 Specific resistivity, Ohm/m
3 Shielding efficiency, dB
4 Electric field (0.1 MHz)
5 Magnetic field (30 MHz)

Table 2 Continued

(1) Пример	Удельное объемное сопротивление, Ом/м (2)	(3) Эффективность экранирования, дБ	
		электрического поля (4) (0,1 МГц)	Магнитного поля (5) (30 МГц)
7	$6.0 \cdot 10^{0}$	9	8
8	$4.7 \cdot 10^{0}$	39	22
9	$9 \cdot 10^{-2}$	50	25
10	$6 \cdot 10^{-1}$	40	20
11	$2 \cdot 10^{-1}$	49	22
12	$6,6 \cdot 10^{-2}$	40	24
13	$3 \cdot 10^{-3}$	66	25
14	$2 \cdot 10^{4}$	0	1
15	$1,2 \cdot 10^{1}$	0	2
16	$2 \cdot 10^{-3}$	73	25
17	$2,5 \cdot 10^{-1}$	9	19
18	$6 \cdot 10^{-4}$	75	26
(6) Прототип	$5 \cdot 10^{-2}$	14	20
Прототип	$2,4 \cdot 10^{-1}$	10	16

Key:
1 Example
2 Specific resistivity, Ohm/m
3 Shielding efficiency, dB
4 Electric field (0.1 MHz)
5 Magnetic field (30 MHz)
6 Prototype